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THE POLLINATION QUESTION

In the following discussion on the pollination of apples and pears it is not the intention to go into any of the research phases of the problem or attempt to explain certain phenomena with which we are continually coming in contact in the study of this problem. It is the endeavor of the Oregon Agricultural Experiment Station merely to set forth some of the practical results obtained in our work throughout the state for several years past and to give a general broad view of the important points to be kept in mind with respect to this phase of orcharding. A future publication will deal exclusively with the research phases.

Experiments dealing with the problems of pollination of pears and apples have been in progress in the Rogue River, Willamette, Hood River and Walla Walla Valleys for the past several years. The spirit of helpful co-operation of the foremost orchardists in these sections has been of the greatest benefit to us in securing valuable data on which to base conclusions, and we wish to express our sincere appreciation to each of these owners for the numerous helps extended.

Every practical orchardist has now come to realize, or if he has not, he should, that one of the most important phases of orcharding is the problem of pollination. It must be considered in selecting any variety for planting. The question has been one of scientific interest for many years and unfortunately considerable has been written on this subject before definite information was at hand, with the result

that many of the recommendations of today must be considered without foundation.

Too many times one is prone to consider that any lack in the setting of fruit is purely and wholly due to the absence of proper pollination. As a matter of fact there are many causes other than pollination which must be taken into account. Among the first of these we may mention the inability of certain varieties to set fruit, or of certain spurs on the tree to mature fruit from the blossoms which occur on them in the spring. To drop their fruit seems to be as much a character of certain varieties as is the color, flavor, or any other character of the variety. From carefully conducted experiments we must conclude that by no means is all the spring and June drop to be attributed to lack of pollination.

Another one of the important causes of dropping of blossoms is the vegetative vigor of the trees. If a tree is growing too vigorously it frequently runs entirely to wood and scarcely produces any blossoms, and the few that it may produce are usually shed very soon after the blooming period is past. The same may be said of trees which are in a very poor condition. While the latter may bloom more profusely than those which are growing vigorously, some blossoms are as incapable of setting fruit as are those on the former.

Insects and diseases also frequently cause the loss of many blooms. Some are destroyed outright by the various diseases, such as scab, anthracnose, or blight and in the case of peaches and plums by the brown rot fungus. Many blossoms may be ruined when quite young by attacks of insects. Even some of the blossoms which may be set are later killed by these same causes before they have made any considerable size and are frequently shed at the time of the so-called June drop.

It is almost too well known to need mentioning that rain or snow during the blooming period is the cause of failure of many blossoms. This loss is due to the fact that much of the pollen is destroyed by rain and the stigmas of the blossoms are injured to such a degree that pollination and consequent fertilization is impossible. Of course no fruit is produced under such conditions. In this connection, however, it may be well to mention the fact that usually all the blossoms do not come on at the same time and enough may meet with favorable conditions to produce a fair crop.

One of the most serious climatic conditions with which we must contend is frost. Injury from this cause is brought about in two ways; first, by winter freezes and second, by spring frosts. In the former instance the fruit buds are either killed outright during the winter, or are injured only to the extent that they are incapable of producing fruit. That is, the flowers expand and without careful inspection appear normal, but on closer examination it is usually found that the pistils or heart of the very young fruit has been killed. Injury from late

spring frosts is manifested in various ways. The young fruit is subject to injury from the time the fruit buds have opened until the time the fruit is as large as a garden pea or even later. If the frost is very severe the young fruit is generally killed outright as is recognized by a very noticeable blackening a few hours after the frost. In certain instances, generally after pollination has occured a light or medium frost does not entirely kill the blossom but seems to allow a certain degree of development. Usually in such instances the seeds are killed and there is little or no development of them, though there may be some. Usually such fruit develops somewhat abnormally, frequently producing in pears what is described as "bull-neck." Such fruit will usually hang on the trees up to the time they are ready to make the last swell before picking time, then they will drop in quantities. Often if not too badly injured they will develop sufficient size to be marketable.

Another cause of the shedding of some fruit, though probably in general of an inconsiderable quantity, is the spraying of trees when in full bloom. Careful experiments conducted along this line by several experimenters have demonstrated that when the trees were thoroughly sprayed before the blossoms had been pollinated they failed to set fruit. Usually, however, if two or three days have elapsed after pollination and before the spraying, such fruits will set perfectly. Furthermore, on most varieties the blossoms open at intervals for several days and one spraying would not be likely to injure all the blossoms in any one cluster.

It will be seen from the foregoing and as pointed out above that we must take into consideration several factors other than pollination when we are looking for the cause of failure of blossoms to set. However, we think it is safe to say that all varieties of pome fruits, at least apples and pears, even though the varieties are termed self-fertile, are benefited by having other varieties planted with them as pollenizers. By the term self-fertile variety we mean one which is capable of setting perfect fruit without the aid of pollen from another variety. By self-sterile we mean that a veriety is not capable of setting fruit without some other variety being planted with it to furnish pollen. One frequently meets with the term partially self-fertile, or partially self-sterile. By this is meant that under certain conditions a limited number of fruits will set. By far the greater number of our varieties must be classed in the self-sterile or partially self-sterile list and as above pointed out it is always best to plant two or more varieties together. However, we must guard against planting too many varieties. One variety as a pollenizer for another will serve every purpose that twenty would. Thus an orchard of Bartletts and d'Anjous would serve to pollinate each other as well as if we planted among them a dozen or more varieties. In the past one of the greatest difficulty has been that the orchardists have gone on

the supposition that if a little is good, more will be better and some have planted all the way from fifteen to twenty varieties, many of them worthless, merely for the sake of securing cross pollination. This is a mistaken idea and one that should be guarded against. Of course, if one wishes to grow a number of varieties for other reasons there can be no objection from a pollination standpoint but otherwise it is to be avoided.

The main point that must be taken into consideration in the study of the pollination problem is the so-called secondary effect of pollen. By this we mean the effect let us say, of Spitzenburg pollen on a Newtown apple in the immediate cross. Much has been written for and against the use of certain pollenizers and we believe that we must conclude that in general there is very little effect other than a change in size of the fruit, increase in percentage of set, and uniformity of crop. Flavor, quality, keeping quality and color are probably not affected in the least.

This subject has been discussed from the earliest times, ever since the pollination problem has begun to be investigated, but from carefully conducted experiments the last several years we believe that we must conclude that if other noticeable effects are manifested they are exceptionally rare indeed. The same conclusions have been reached by other very careful workers along this line. Too much credence has been placed in sporadic instances of apparent effect. Thus we frequently hear that if a Spitzenburg apple has a bright yellow band from calyx to stem, it is considered to have been pollinated by a Newtown, or if a Ben Davis has a similarly placed dark red band, that it was pollinated by a Baldwin. These suppositions must be held to be false and the effect attributed rather to bud variation. We have met with many instances of this sort and are forced to conclude that the pollen which was used had absolutely nothing to do with the color. Soil, the methods of pruning, fertilization, cultivation, irrigation and other orchard practices will influence color, quality, etc., far more than will the pollen of neighboring varieties. As had been mentioned, the three greatest factors influenced by pollination, are size, percentage of set, and uniformity. Certain varieties of pollen may possibly produce, when applied to any given variety a smaller fruit than normal, and certain other varieties may produce a larger fruit than normal. One of the points that should be emphasized in this consideration is that cross-fertilized fruits generally produce more seeds than do those which are self-fertilized and furthermore the greater the number of seeds usually the greater the size and weight of the fruit itself. In fact seed production seems to be the exciting cause of the growth of the flesh of the fruit. Often in self-fertilized fruits while the fruit will come to full maturity, it is not more than a fifth or quarter of the size of a cross-fertilized fruit and is generally seedless. Cases of fruit production without pollination are recorded, but among the pomes at least, this

condition must be considered exceptional.

It may be well also to call attention to the fact that pears will not serve to pollinate apples nor will apples pollinate pears though the various species of apples will interpollinate and the same holds true for pears. Cherries, plums, or peaches also cannot be considered in any way to serve as pollenizers for either apples or pears of any variety.

The question then arises what are the essentials of a good pollenizer. First of all we may say that the two varieties must bloom at the same time. That fact is self-evident for if one variety is out of bloom before the other begins it may as well not be there so far as furnishing pollen is concerned. Second, the two varieties must have an affinity for each other. That is to say, the pollen of one must be acceptable to the pistils of the other; and such as is going to give the best and most uniform fruits and greatest percentage of set. Third, both must be good pollen producers. If a shy pollen bearer is planted with an abundant pollen bearer, the variety which produces little pollen will, of course, be greatly benefited but there will be little reciprocal action, as is readily seen. Such an example would be the planting of the Winesap and Rome Beauty. The Winesap produces very little pollen, whereas the Rome Beauty produces plenty. The former, therefore, would have an abundance of Rome Beauty pollen to fall back on, but the Rome Beauty would stand slight chance of being crossed by the Winesap. Fourth, both varieties preferably should be commercial. This is simply, of course, a practical point in economics. Fifth, both varieties should come into flower at about the same age. For example, were the idea to pollinate the Wagner with Northern Spy, the result would be that for several years the Wagener would be without a pollenizer, in that it comes into bearing much earlier than the Northern Spy. Such a discrepancy can be made up in a measure by the use as fillers, of dwarf trees of the late bearing variety. Such dwarfs will bear several years in advance of the standard and later can be readily removed.

Careful experimentation has shown that very little, if any pollen of our tree fruits other than nut trees, is transported by the wind. Probably 99 per cent or more of the transfer of pollen is done by insects. Prime among these may be mentioned the honey bee. Bumble bees, ants, flies, moths and short-tongued bees play an important part. However, there is no doubt but that the common hive bee is by far the best of all, and it will pay every orchardist to have a few stands among his trees.

In putting out an orchard the system recommended to secure the best results from pollination is to plant four rows of each variety, be there two or more. Such an arrangement would allow for convenient harvesting, pruning, etc., and serves better than planting four and one, which is sometimes recommended. Of course, so far as pollination is concerned the latter arrangement is entirely permissible if one wishes

to grow a larger proportion of one variety than another, but in general if one can have the varieties blocked more or less many of the orchard operations will be simplified. For as is well known, the several varieties frequently require quite different attention. To illustrate, if the Bartlett were not used to pollinate d'Anjou pears, and the same were planted four rows of d'Anjou to one of Bartlett, it is readily seen that the Bartletts must be harvested earlier than the d'Anjou with the result that there would be considerable tramping and hauling through the latter, thus not only compacting the ground unnecessarily, but also incurring the risk of knocking off fruit, disturbing props, etc. Many similar instances could be cited.

While by no means complete, the following list of commercial varieties most grown at the present time are grouped according to the desirability of interplanting to secure best results from pollination. Any variety occurring in any column is well pollinated by any one or more of the varieties in the same column.

APPLES.

Early.	Late.	
*Gravenstein	Arkansas Black	Ortley
Oldenburg	Baldwin	Red Cheek Pippin
Red Astrachan	Ben Davis	Rome Beauty
Tetosky	Black Twig	Spitzenburg
Wealthy	Gano	Wagener
*Yellow Transparent	Grimes Golden	Willow Twig
	Johnathan	Winesap (a shy pollen producer generally.)
	McIntosh	
	Newtown	White Winter Pearmain
	Northern Spy	Yellow Bellflower

PEARS.

Early.		Late.	
Bartlett	Howell	Angouleme	Easter Beurre
Clairgeau	Keiffer	Bosc	P. Barry
d'Anjou		Du Comice	Winter Nelis

* In many localities these varieties bloom sufficiently late to serve to pollinate many of those listed as late bloomers.

It must be remembered in this connection that in general the greater the altitude, or the farther north varieties are grown, the later in the season will be their blooming periods and that the so-called early bloomers come very little in advance of the late bloomers. In milder climates or lower altitudes these same early varieties may be entirely out of bloom before the late varieties begin. Thus, also. it may be found, especially among the late bloomers, that certain varie- in other localities they will bloom nearly or entirely together and the

in other locaities they will bloom nearly or entirely together and the entire blooming season shortened. The lists are based on general Oregon conditions for a normal season.

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